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**Course Instructor**: Shakira Provasoli

**Class**: Water, Energy, and Waste:Integrating Themes of Sustainability into Your Classroom (NYSunWorks)

**Midterm:** Lesson Plan

**HOW BIG IS YOUR FOOTPRINT? **

**Overview:** The ecological footprint concept is a way to roughly measure the impact of a person’s choices on the environment. People have become so accustomed to their diet, cars, homes, and energy usage that they don’t realize that the Earth will not be able to provide the needed resources indefinitely. When students go online to calculate how many Earths it would take if everyone on the planet lives the way that they do, they will be astonished. For many students, it is the beginning of increased awareness about the delicate balance of the planet.

**Objectives:** Students will:

1. Increase awareness of the impact of individual choices on the Earth.

This awareness is to result in a goal to reduce their personal impact (footprint).

1. Learn the mean, median, mode, and standard deviation of a set of data.

**Performance Standard:**

K-8 Science Scope and Sequence:

UNIT 4

EXPLORING ECOSYSTEMS

Identify populations within a community that are in competition with one another for resources. LE 3.2a

Describe the way humans:

• Depend on their natural and constructed environment.

• Have changed their environment over time. LE 7.2b,c LE 7.2d

Identify examples where human activity has had a beneficial or harmful effect on other organisms LE 7.2b,c LE 7.2d

1.b. Plan and conduct a simple investigation.

1.c. Employ simple equipment and tools to gather data and extend the senses

**Professional Development Competency:**

Domain 3: Instruction

Competency 3c – Engaging students in Learning

**Subjects:** Science andMathematics (Statistics or a Statistics unit in General Math, Algebra 1 or 2)

**Grade Level:** 8

**Time:** 2 class periods (50 minutes each) or 1 block period.

**Materials:**

* Access to the Internet. If a class set of computers is available, it will take each student about 15 minutes to complete the questionnaire. If only a handful of computers are available, then the calculation for the number of acres needed to support each students lifestyle will take a little longer.
* Graph paper or poster paper
* Calculators

**Background Information: **

* One possible introduction to the lesson could be a discussion of how much food a farm produces.
* Have students guess the number of acres in a small farm. Students might not even know how big an acre is, roughly 40,000 square feet or a square plot of land about 200 feet by 200 feet.
* Could 1 acre provide all the food needed for one person for one year?
* What about provide the materials needed to build a home?
* What about heating costs? Could the farm provide wood for a fireplace?
* Could the farm provide energy for equipment? Students may realize that a farm cannot provide gasoline or electricity (usually). So there are other resources needed to provide our comfort and lifestyle for a year. What is the average number of acres to provide for the needs of our students? What is the greatest amount? What is the least amount? Suppose this number of acres were to be translated into the number of planet Earths needed if everyone on the planet lived as a member of the class does. What would be a reasonable number?

**Procedure/Activity** 

1. Students will go online to the URL 13. Have students calculate the mean [www.mec.ca/Apps/ecoCalc/ecoCalc.jsp](http://www.mec.ca/Apps/ecoCalc/ecoCalc.jsp)

or

<http://www.earthday.net/footprint/index..asp>

There are other sites that calculate an ecological footprint; you can do a google search to find others. This site has 13 questions that students are to answer. From their answers, the site calculates the number of acres needed to sustain that person’s choices. The site also converts the acres into the number of Earths needed to sustain the planet’s population if everyone lived in the same manner.

1. When students have arrived at the number of acres and Earths, you may collect all of their data in one of several ways. Each student can write their values on the board, or if privacy is critical (and some students may feel awkward about how many Earths they are using), then students may write their values on a small piece of paper and the results could be collated, copied, and distributed the next day, without names attached.
2. Have students calculate the mean number of planets needed, and the mean number of acres needed to sustain the members of the class. Students should prepare a graph of the data, either in bar graph form, a number line, or a stem and leaf plot. Identify the high and low values for the class. How is the mean affected by these values?

4. Demonstrate how to calculate the standard deviation for a set of data. This measure of variation describes the spread of the data. If the standard deviation is more than 50% of the mean, then there may be some people in the class with large values for acreage or Earths.

**CONCLUSION DISCUSSION**

1. What is the average number of acres for the students in the class? What is the average number of Earth’s needed?
2. Which statistic would you use if you wanted to point out the lack of awareness of the environment? Which statistic would you use if you did not want to alarm the public?
3. What is the biggest factor that contributes to a high number of acres? Or, which area do you think could conserve the most of the earth’s resources?
4. Suppose you were to calculate the mean again eliminating the highest 3 values. Is the mean still greater than 1 Earth? What does that mean for future generations? Is it enough to change only the extreme lifestyles? Or does everyone need to change if we are to get the number down to below 1 Earth needed?
5. What are the next steps? How can we carry this message to other people? The students might want to have their parents and other family members take the online questionnaire. Perhaps later in the year the class can repeat the lesson and see if the average number of acres has been reduced.

**RESOURCES**

The Display of Quantitative Information, Edward Tufte. Mathematics: A Human Endeavor,

Harold Jacobs, Freeman Publishing Elementary Statistics, Ron Larson Exploring Data

[http://www.myfootprint.org](http://www.myfootprint.org/)

Hudson River Foundation, <http://www.hudsonriver.org/hrif/>

NYC Urban Field Station <http://www.nrs.fs.fed.us/nyc/>

Pictures of different energy uses found within google image search.

http://www.images.google.com

“2007 Saturn Sky”. 2007. U.S. Government.

http://www.fueleconomy.gov/feg/noframes/23094.shtml

“2007 Ferrari 612 Scageitetti”. 2007. U.S. Government.

http://www.fueleconomy.gov/feg/2001cartablef.jsp

“Conserve Resources”. 2007. U.S. Government. http://www.fueleconomy.gov/feg/consres.shtml

Ecological Footprint Resource CD. 2004. Redefining Progress.

[http://www.redefiningprogress.org](http://www.redefiningprogress.org/)

**Assessment: Rubric**

**How Big Is Your Footprint?**

**Rubric for Conducting an Experiment in the Lab**

**Task description:** Conduct the assigned lab using the procedures and methods described below. Turn in your laboratory report at the beginning of the next class period.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Exemplary** | **Competent** | **Needs Work** |
| **Materials** | All materials needed are present and entered on the lab report. The materials are appropriate for the procedure. The student is not wasteful of the materials. | All materials needed are present, but not all are entered on the lab report, or some materials are absent and must be obtained during the procedure. The materials are appropriate for the procedure. | All materials needed are not present and are not entered on the lab report. The materials are not all appropriate for the procedure or there are some major omissions. |
| **Procedure** | The procedure is well designed and allows control of all variables selected. All stages of the procedure are entered on the lab report. | The procedure could be more efficiently designed, but it allows control of all variables selected. Most stages of the procedure are entered on the lab report. | The procedure does not allow control of all variables selected. Many stages of the procedure are not entered on the lab report. |
| **Courtesy and safety** | While conducting the procedure, the student is tidy, respectful of others, mindful of safety, and leaves the area clean. | While conducting the procedure, the student is mostly tidy, sometimes respectful of others, sometimes mindful of safety, and leaves the area clean only after being reminded. | While conducting the procedure, the student is untidy, not respectful of others, not mindful of safety, and leaves the area messy even after being reminded. |
| **Purpose** | Research question and hypothesis are stated clearly, and the relationship between the two is clear. The variables are selected. | Research question and hypothesis are stated, but one or both are not as clear as they might be, or the relationship between the two is unclear. The variables are selected. | Research question and hypothesis are not stated clearly, and the relationship between the two is unclear or absent. The variables are not selected. |
| **Data collection** | Raw data, including units, are recorded in a way that is appropriate and clear. The title of the data table is included. | Raw data, including units, are recorded although not as clearly or appropriately as they might be. The title of the data table is included. | Raw data, including units, are not recorded in a way that is appropriate and clear. The title of the data table is not included. |
| **Data analysis** | Data are presented in ways (charts, tables, graphs) that best facilitate understanding and interpretation. Error analysis is included. | Data are presented in ways (charts, tables, graphs) that can be understood and interpreted, although not as clearly as they might be. Error analysis is included. | Data are presented in ways (charts, tables, graphs) that are very unclear. Error analysis is not included. |
| **Evaluation of experiment** | The results are fully interpreted and compared with literature values. The limitations and weaknesses are discussed and suggestions are made as to how to limit or eliminate them. | The results are interpreted and compared with literature values, but not as fully as they might be. The limitations and weaknesses are discussed, but few or no suggestions are made as to how to limit or eliminate them. | The results are not interpreted in a logical way or compared with literature values. The limitations and weaknesses are not discussed, nor are suggestions made as to how to limit or eliminate them. |